XXIX. *ALLUAUDELLA HIMALAYENSIS*, A NEW SPECIES OF DEGENERATE (♂) COCKROACH.

With an account of the venation found in the Genera *Cardax* and *Alluaudella*.

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Introductory.

The genus *Cardax* was founded by Mr. Shelford in the year 1908 for the reception of a little *Embia*-like cockroach, male specimens of which were attracted to the lights in Mr. Green's bungalow at Peradeniya in Ceylon. They were forwarded to Mr. Shelford by Dr. Willey, and received the name *Cardax willeyi*. During the present year Mr. Shelford has described a similar male cockroach from the Kulumusi Caves near Tanga, in German East Africa. For this species he has founded a separate genus, the full name of the species being *Alluaudella cavernicola*. From his descriptions the generic distinctions appear to be: the smaller size of the eyes in the latter; the form of the pronotum, which covers the vertex of the head in the former but not in the latter; and differences in the venation.

During a recent visit of Dr. Annandale to Kurseong, in the Darjiling district of the Eastern Himalayas (4,700 ft.), a single male specimen of yet another species of *Embia*-like cockroach was found. Like *Cardax willeyi* it was attracted to the light of a house, where it was captured. This specimen has the eyes well-developed as in *Cardax*, but has no ocelli; the vertex of the head is free of the pronotum, as in *Alluaudella*, whilst the venation is unlike that of either genus.

During a recent visit to Peradeniya I had the good fortune to obtain several specimens of *Cardax willeyi*, all of which were males taken at light in Mr. Green's bungalow. These show considerable variation in their venation, and lead me to suppose that the differences in venation between *Cadax willeyi*, *Alluaudella cavernicola*, and the Kurseong species are of much less importance than appears at first sight. I propose therefore in the present paper to describe this variability in the venation of *Cardax willeyi*; to emphasize the fundamental uniformity found in the venation of the three species; to point out the probable relation of this type of venation to that found in other cockroaches; to

describe the Kurseong specimen under the name *Alluaudella himalayensis*; and to redefine the genera *Cardax* and *Alluaudella* in accordance with the fresh facts brought forward.

I have to thank Mr. Green for lending me his series of specimens of *Cardax willeyi*, including several of the collection of which the part sent to Shelford formed the basis of the original description of the species.

Variation in the venation of Cardax willeyi, *Shelford.*

The venation of both the tegmina and wings of *Cardax willeyi* consists of a series of well-defined veins whose origin is practically coincident with the origin of the tegmen (or wing), and which run direct to the margin of that organ, giving off but few branches in their course; and of a series of "secondary" veins having as a rule no defined origin and lying singly between these "primary" veins as they may be termed. The branching of the primary veins is of two kinds. Firstly, branching near the origin, to form in all six long veins which it will be convenient to refer to as primary veins

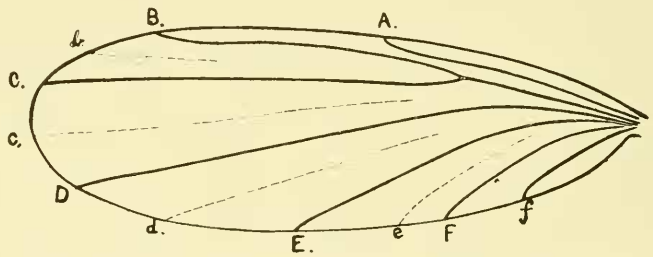

Diagram of the venation of the tegmen of Cardax willeyi (♂).

The lettering of the veins corresponds to that used provisionally in the text; the probable relation of these veins to those found in more highly organized cockroach wings is described on p. 310. In the tegmen of *Cardax willeyi* the only difference between the nomenclature here advocated and that adopted by Shelford in his description is that Shelford regards "vein C" as a fork of the radial instead of as a distinct vein corresponding to the *vena spuria*. Primary veins are indicated by heavy lines; secondary ones by dotted lines. Vein *f* is shown by a heavy line, as it is at least as likely to correspond to a true branch of the anal (*i.e.*, to correspond strictly to an axillary vein of other forms) as to be one the series of secondary veins which are here supposed to have possibly arisen *de novo* in the degenerate forms.

A—F respectively[1] (see text fig.); these branches arise in a manner which appears to be constant, and to be the same in all three species of cockroach particularly dealt with in the present paper, differing, however, in the tegmina and wings. And, secondly, branching which occurs nearer the margin of the wing, which is variable—except perhaps in the case of vein E of the wing which in every specimen I have seen is forked, the division occurring further

[1] In order to avoid confusion: the relation of these veins to those of more typical cockroaches will be considered later.

from the margin than in the case of any other vein. Thus vein D of the tegmen (anterior ulnar of Shelford's nomenclature) may be forked near the end (see fig. 1), and Shelford states that the posterior ulnar (vein E) may be similarly forked; and in the wing vein C may (figs 1, 2 and 3) or may not (fig. 4B) be forked; and in the wing vein C may (figs. 1, 2 and 3) or may not (fig. 4) be forked.

But it is in the secondary veins (*b-f*) that the variations occur which are of special importance in connection with the relation between the types of venation found in these three species. These veins are usually connected with the primary veins between which they lie by a series of more or less ill-defined and very irregular cross-veins. The cross-veins are quite irregular in position, in number, and in intensity; and in some cases the secondary veins may appear to arise as definite branches of some primary vein, and in others very nearly to do so. Thus in the tegmen vein *b* often appears as a branch of vein B (see figs. 2 and 4A) or of vein C (see fig. 2); and in the specimen shown in fig. 3 vein *e* of both tegmina (but one more than the other) tends to appear as a branch of vein E and vein *c* of the right wing shows a strong tendency to appear simply as a branch of C and *d* of E.

Having thus established the fact that in *Cardax willeyi* the venation consists of a series of constant primary veins (any of which may, however, bifurcate near the margin of the wing), alternating with secondary veins, which show a tendency to fuse with them and so to appear as branches from them, the venation of *Alluaudella carvernicola* and *A. himalayensis* can easily be shown to consist of the same elements somewhat more definitely combined. But before doing this it will be necessary to describe the new species *Alluaudella himalayensis*.

Description of Alluaudella himalayensis, sp. n.

(Figs. 5A and 5B.)

♂ (one specimen only): size, pubescence and antennae as in *Cardax willeyi*; eyes well developed and far apart; ocelli absent; vertex of head not covered by pronotum; pronotum trapezoidal, punctured and pubescent behind and at the sides, with longer hairs more sparsely scattered over a central area extending as a narrow strip to the anterior margin; shape of pronotum, however, not so distinctly transverse as in *Cardax willeyi*. Tegmina and wings resembling those of *Cardax willeyi* in shape, size, texture and pubescence; mediastinal vein very short in tegmina, in the wings rudimentary (in one) or absent (in the other); radial vein rather faint in the tegmina, coincident with a longitudinal crease; no secondary vein developed in front of vein C (= *vena spuria*, see below p. 310) in tegmen or wing; base of vein C received by vein B (= radial) in the tegmen very close to the origin; vein E (= posterior ulnar) in the tegmen receives the base of the succeeding secondary vein (*e*), which is strongly developed and appears simply as a branch of it. Legs long and slender; apical spines of tibia

apparently somewhat fewer than is usual in *Cardax willeyi*; in all other respects the legs resemble those of that species.

Comparative discussion of the venation found in Cardax willeyi *and in* Alluaudella cavernicola *and* A. himalayensis.

The diagram given above (text-fig., p. 308) of the tegmen of *Cardax willeyi* illustrates the conclusions thus arrived at with regard to the fundamental plan of the venation of that species and will form a useful starting-point in the present discussion.

On comparing this diagram with Shelford's figs. of *Alluaudella cavernicola* and with fig. 5A of the present paper representing *A. himalayensis*, it will be seen that the "triramose posterior ulna" of the tegmen of former is the result of the fusion of veins *d* and *e* with vein E (a conclusion which is perhaps further supported by the abrupt junction of the anterior of the apparent branches with the main trunk); whilst the biramose character of this vein in *A. himalayensis* is similarly due to the complete fusion of the proximal end of vein *e* with it. Further, it will be noticed that vein C differs from all the other primary veins in having a different point of origin in the tegmina and wings, arising from vein B in the former and vein D in the latter. Thus it behaves in the two alar organs taken together as the secondary veins behave within the limits of either of these organs in a single species; from which it may be supposed that its ultimate derivation has been from some vein distinct (as the secondary veins now usually are) from the system radiating from the origin of the organ. From this the following homologies for the different primary veins follow quite simply; A = mediastinal, B = radial, C = vena spuria, D = anterior ulnar, E = posterior ulnar, F = anal.

With regard to the origin of the secondary veins there is little definite evidence. It may be pointed out, however, that between the two branches of a forked primary vein traces of a rudimentary vein (see figs. 1 2 and 3, *x*) may sometimes be seen. This vein extends from the margin about half way between the two branches of the primary vein The secondary veins may perhaps have arisen in this way, and becoming functional as strengthening organs have been fixed by the action of natural selection; though why the usual strengthening veins, arising as branches of the primary veins, should have been replaced in this way it is difficult to see.

It will be noted that in this discussion I have assumed that these simple cockroaches are degenerate rather than primative. I do this because the highly specialized asymmetrical genitalia (see figs. 2 & 3), and the absence of paired maxillulæ, are indications of derivation from a normal Blattid rather than immediately from some more Thysanure-like ancestor; and because the junction of the *vena spuria* sometimes with the radial and sometimes with the anterior ulna indicates that this vein was originally free proximally precisely as it is in other cockroaches. It will be interesting to see, when the

female of one of these forms is discovered, whether it has undergone any simplification parallel to that found in the male; but in view of the restriction of the simplification in the male apparently to the wings, it is perhaps more probable that this is associated with an increase in the specialization of the female for the sedentary life which she must be supposed to lead.

Redescription of genera and species—a summary.

The genera *Cardax* and *Alluaudella* may be at once distinguished from all other known cockroaches by the simplicity of their venation. In both tegmina and wings a *vena spuria* is present which has combined with the mediastinal (which however may be rudimentary) radial, anterior and posterior ulnar, and anal veins to form a definite radial system; and alternating with these veins is a system of secondary veins essentially arising freely in the wing and extending to the margin, but often connected by irregularly developed cross-veins with the primary veins on one or both sides of them, and sometimes so completely joined to one of these veins as to appear simply as a branch of it. So far as is known the posterior ulnar vein of the wing (but not of the tegmen) is invariably forked; and other primary veins are sometimes also forked near the margin of the wing or tegmen in certain specimens. Differences in the venation are therefore apt to be apparently much greater than they really are, and in the three species now known they can hardly be considered of generic importance.

The genera may be distinguished from each other by the absence of ocelli and the exposure of the vertex of the head in *Alluaudella*; and the presence of ocelli and covering of the vertex by the pronotum in *Cardax*.

The latter genus contains one known species only, *C. willeyi*, Shelford; the former contains two species which may be distinguished as follows: eyes reduced (posterior ulnar vein of tegmen joined by the bases of the secondary veins on each side of it), *A. cavernicola*, Shelford; eyes large (posterior ulnar vein of tegmen joined by the base of the secondary vein behind it only, other secondary veins of tegmina and all those of the wings with a distinct tendency likewise to arise from some point in the course of the primary vein immediately in front of them), *A. himalayensis*, sp. n., described above.

List of papers referred to.

1908. Shelford, R.—"Some new Genera and Species of Blattidæ, with notes on the Form of the Pronotum in the subfamily Perisphæriinæ." Ann. Mag. Nat. Hist. (8) i, pp. 157—177, pl. ix-x (1908).

1910. Shelford, R.—"A new cavernicolous Cockroach." Ann. Mag. Nat. Hist. (8) vi, pp. 114—116, text-figs. (1910).